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A Research on Various Architectural Aspects of Cloud Enabled LMS for E-Learning System

Mohammed Khalid Kaleem[1]* Dr. Manaullah Abid Husain[2] Dr. Suneel Dubey[3]

[1]Research Scholar, Maharishi University of Information Technology, Lucknow, India

[2]Associate Professor, Department of Electrical Engineering, Jamia Millia Ismalia, New Delhi, India

[3]Associate Professor, Dept. of Computer Science & Information Technology, Maharishi University of Information Technology, Lucknow, India

Abstract – Cloud-based computing is arguably the most talked-about recent trend in the field of information technology (IT). Claims in the IT literature include significant financial and operational benefits. The literature also reports some concerns, for example, with the security of data that is stored and processed on servers not owned or controlled by the organization that owns the data. However, there is a growing trend towards the use of cloud-based IT services of all kinds, including educational services such as cloud-based hosting of courses.

Nowadays the LMSs are the main software tool for organizing and supporting contemporary e-learning. Cloud computing technologies are widely used not only for business purposes, but also in education area. There are lots of cloud-based Learning Management Systems, providing services for collaborating, evaluating and creating learning content. The aim of the current work is to research, evaluate and compare some of the cloud- based LMSs. A set of common criteria, used for LMSs, is implemented for estimating the advantages and disadvantages of cloud-based systems for e-learning.

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INTRODUCTION

The new information technologies have changed the way of teaching and learning. Being the state of the art in education means that the institutions providing e-learning should offer new opportunities for self-regulated e-learning consistent with the new expectations and needs of nowadays digital learners.

Combining the features of traditional learning systems with the cloud-based ones will give the organizations a powerful tool that is cost effective, easy to maintain, secure and engaging learners and teachers.

The aim of the current work is to explore cloud-based LMSs, their advantages and disadvantages and to propose a number of selecting criteria for choosing the most appropriate one for educational and non-educational institutions.

Recesso state "Learning Management Systems (LMS) play a central role in the Web-based e-learning scenario. It connects learning contents and learners together in a standardized manner. It manages users, learning materials (in the form of objects in Content Management System (CMS)) and learning events. It manages and administers learning progress and keep track on learning performance. It manages and administers administrative tasks. LMS is a software system designed to facilitate administrative tasks as well as student participation in e-learning materials". Digital technologies continue to influence the way we find, create, share, and negotiate information, ideas and ways we think about knowledge itself. Learning, education, and training continue to extend the reach of classrooms and training rooms by including a more organic, integrated array of learning experiences and support – available "anywhere anytime for anybody". Work styles are shifting from individual accomplishment to teams, communities of practice, and collaboration. In the midst of all these changes, the LMS is the foundation for e-model and matures from its 1.0, "publishing Web" antecedents to accommodate the demands of the 2.0, "participative Web" possibilities. With the emergence of web service based tools, the expectations of learning itself is in a state of transformation. These tools include RIAs, (rich internet applications), social media, SaaS (software as a service), BPMS (business process management systems), UGC (user-generated content, including photos, slideshows, and videos), the growth of commercially published apps and e-books, ECM (enterprise content management), semantic tools like Twine, and socially bookmarked

resource sites like Delicious. The best learning organizations will take a holistic approach to causing shifts, through delivering content, creating access channels, and supporting dynamic containers, social networks, and resource locators. Today"s emerging LMS architecture allows enterprises to offer services, support inquiry, and track user behavior across a wide variety of sites and sets of devices. Comprehensively and simultaneously tracking success of informal and traditional learning activities creates an opportunity for new management solutions to take a foothold in a previously traditional market.

Today, there is an urgent demand of higher education architecture, based on Learning Management Systems. A framework for understanding these systems is generally been used and quality attributes like portability, interoperability, reusability and modifiability can be achieved. In this exploratory research paper, after analyzing the LMS based architecture, a suitable model is suggested which aimed to engineer Open Learning Management Systems. This paper is based upon available pedagogically proved facts & available standards as well as well-established software engineering techniques. Before understanding about fifth generation higher education model, there is a need to review the advancement in different generations of education models. The story begins with the transformation of a relatively simple computer network used by a few researchers into a global Internet, involving hundreds of millions of people. The next few years will encompass the significant impact of broadband, wireless, smart cars, smart fridges, streaming media, voice recognition and the inevitable growth of new Internet technology like high speed fiber based back-bone in this 4G era. Internet also has the power to transform universities. The distance education itself has evolved through the successive four generations. Many universities have already taken initiative to drive distance education through fifth generation technology. The fifth generation distance education is essentially a derivation of the fourth generation, which aims to capitalize on the features of the Internet and its services around LMS. A central feature of fifth generation higher education model is the development of a customizable e- Interface, a campus portal through which students, staff and other stakeholders can engage with the university in a highly interactive and compelling manner. To become successful in the emerging global lifelong learning market, a university needs to create a campus portal that will achieve a degree of interactivity, user friendliness and personalization that does not exist in the vast majority of campus web sites today.

Education or Learning is an important component of life and No human beings are able to survive properly without education. Now a days, there are lots of paradigms for getting knowledge or learn something. One of the most promising paradigms for education is e-learning. E-learning is commonly referred to the intentional use of networked information and communications technology (ICT) in teaching and learning. Some other terms are also used to describe this mode of teaching and learning including online learning, virtual learning, distributed learning, network and web-based learning. The growth of e-learning is directly related to the increasing access to ICT, as well as its decreasing cost. The capacity of ICT to support multimedia resource-based learning and teaching is also relevant to the growing interest in e-learning. Poor or insufficient technology infrastructure can cause more damage than good to teachers, students and the learning experience. While the costs of the hardware and software are falling, often there are other costs that have not been factored into the deployment of e-learning ventures. The most important of these include the costs of infrastructure support and its maintenance and the appropriate training of staff to enable them to make the most of the technology. Cloud Computing is a new paradigm that provides an appropriate pool of computing resources with its dynamic scalability and usage of virtualized resources as a service through the Internet. The resources can be network servers, applications, platforms, infrastructure segments and services. Cloud computing deliver services autonomously based on demand and provides sufficient network access, data resource environment and effectual flexibility. This technology is used for more efficient and cost effective computing by centralizing storage, memory, computing capacity of PC's and servers. With the tremendous advantages of cloud computing, we expect this technology to revolutionize the field of e-learning education. Cloud computing applications provide flexibility for all educational universities, schools and institutions. The cloud platform in institutions' campuses provides effective infrastructure and deployment model for their dynamic demands. The benefits of cloud computing can support education institutions to resolve some of the common challenges such as cost reduction, quick and effective communication, security, privacy, flexibility and accessibility. "Cloud computing" is the next accepted action in the evolution of on-demand information technology services and products. Cloud computing allows to move the processing effort from the local devices to the data center facilities. The software is seen as a service and the applications and data are stored on multiple servers that can be accessed from the Internet. However, in traditional web-based e-learning mode, system construction and maintenance are located in interior of educational institutions or enterprises, which results in a lot of problems existed. Cloud computing has many advantages such as expected performance, reduced upfront investment (i.e., software, hardware, and professional staff to maintain servers and upgrade software), high availability, reduced launching time, infinite scalability, tremendous fault-tolerance

capability, and accessibility, enhanced collaboration, and mobility, allow users to use any device, such as a mobile phone, personal computer (PC) etc. Cloud computing is becoming an attractive technology due to its dynamic scalability and effective usage of the resources; it can be utilized under circumstances where the availability of resources is limited. This paper presents the impact of using cloud computing upon e-learning solutions development.

E-learning includes all forms of electronically supported learning and teaching. The information and communication systems, whether networked learning or not, serve as specific media to implement the learning process. This often involves both out-of-classroom and in-classroom educational experiences via technology, even as advances continue in regard to devices and curriculum. Abbreviations like CBT (Computer-Based Training), IBT (Internet-Based Training) or WBT (Web-Based Training) have been used as synonyms to e-learning.

LEARNING MANAGEMENT SYSTEMS (LMS)

Learning management systems are one of the main tools for conducting quality online training. They are platforms for user management in their interaction with educational content that is created and presented in a suitable format. These systems are web-based, which facilitates the access to them.

The accent is on the students - their registration, tracking activity and progress through course assignments and other activities enabling assessment and evaluation. These systems are mainly used in blended learning, which combines elements of the traditional way of teaching in the classroom and the specifics of the e - learning. They can be used both in educational institutions and the business staff training.

According to (1) required key features of such systems are:

- **Integration with other systems** - synchronization of the data with other information systems allows new members of the organization to be added to the e-learning system and have their respective roles assigned;
- **Administration tools** - administrator should manage user accounts, define roles, create and manage courses, have full access to the system. The most important requirement is that the system should be operated via an easy and accessible interface;
- **Access to content** - this includes the e-learning environment, teaching methods, language in which the content is delivered and the users of the content;
- **Creating content** - includes creating, maintaining and storing educational content;
- **Evaluation and knowledge management** - activities such as assignments and tests allow assessment and monitoring the skills and knowledge of the learners;
- **Evaluation tools** - evaluating in the course itself gives valuable feedback to developers about the functionality and effectiveness of the system;
- **Support standards** - enables learning content to be available in other LMS, which support appropriate standards;
- **Configuration** - it is desirable the system to allow set up and customization to the needs of the organization;
- **Security** - security is an important part of any system. Personal data of users stored in it should be password protected and encrypted.

The growing number of open source LMSs such as Moodle, Camilo LMS, Canvas LMS, a Tutor LMS, e-Front LMS, OLAT LMS, Sakai LMS etc., allows their widespread use in education and created communities support their continuous development and maintenance.

LMS BASED OPEN LEARNING ARCHITECTURE

This architecture as shown in fig 1 comprises four key components, the Front End Interface (FEI), the Information Processing Center (IPC), the Learning Management System (LMS), and the Open Adapter Pool (OAP). The key ideas shown by the diagram are the relationships between the components, the physical separation of each component, and the role of the LMS as a facilitator of information and context.

IPC - The IPC consists of enterprise applications that are deployed on the institute infrastructure. In addition to providing information about faculty and students, the IPC fills other responsibilities as well. As the IPC consists of many systems that support the institute, only those that apply to the integration of the LMS are represented in the diagram.

AV Server: - Server used to provide streaming audio and video. Most of the digital media owned by the

university is provided through this server and is made available through a player that can be embedded into virtually any web site.

CR Server - The content Repository Server is used as a repository for documents and files. These repositories are under version control and are made searchable through a common web interface. Users can share documents using a static URL which links directly to a document.

Validity Server - The Validity Server currently consists of an integration layer and a set of Active Directory and LDAP identity systems. These systems contain simple identity information and provide authentication services to other enterprise systems.

ERP Server - The ERP server for the university contains the current student and employee information as well as the course to user relationship.

Learning Management System - The Learning Management System (LMS) serves as a provider of internal system and administration services. Courses, Staff & Students' information's are stored locally and is synced with student, faculty and administrators' information from the institute's ERP server. The users of the LMS create different taxonomies. These taxonomies simply provide a framework for organizing individuals in the system. It also contains a set of tools that can be used by the target-group. Groups are created either from existing courses or Staff or students or completely ad-hoc. Groups are the foundation of all gathering that occurs at the institute.

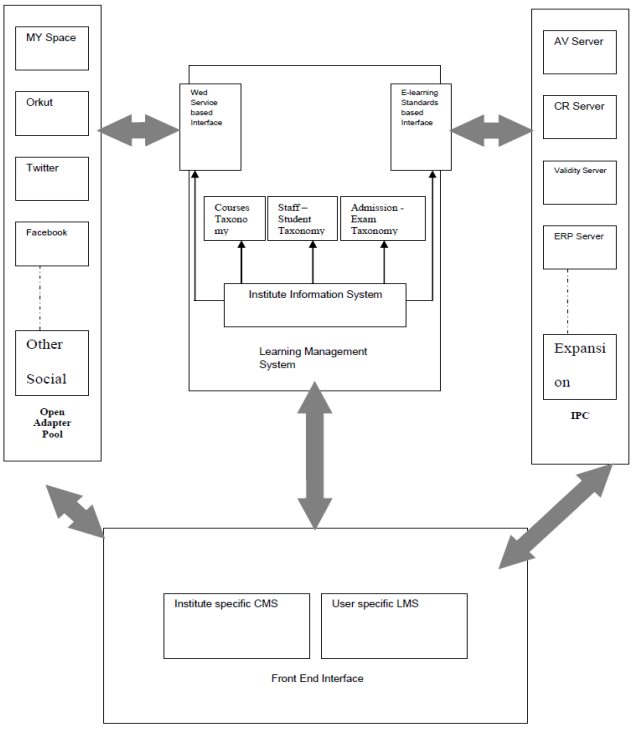

Fig 1: Open Learning Architecture.

They provide users with a workspace to collaborate and share information. The tools that they use are tools integrated into the LMS through the adapter framework. Courses are specialized groups with added tools and are created by the system based on a taxonomy that comes from the institute ERP and are created and destroyed by the system.

The additional tools that are made available include Exam and Admission information. Functionality can be added by putting more adapters. The interfaces to the LMS are crucial. They provide the groups and courses with the tools that the users in the group will use. These interfaces also provide back-end developers with a way to get group and course taxonomies from the system such that they can provide context to their external applications. In addition to an open service based API, the LMS includes a e-learning standards based (e.g. SCORM 2004) interface. This interface allows the creation of SCORM compliant assignments and tests by the university and provides great flexibility in the medium by which they can be created.

Front End Interface - In a traditional LMS, the user interface is largely static based on the design by the engineers who built the system. The presentation layer, however, will be better suited to the user-base if it is created and maintained by the university. This will allow administrators to enable and disable functionality, incorporate university approved branding, and integrate online and self-hosted web technologies seamlessly. In the proposed architecture, the presentation layer of the LMS is completely separate from the core systems. This allows the institute to tie their existing CMS system and the LMS into the institute web space. The flexibility that this architecture provides would promote a single and consistent view to all the tools the university and the web have to offer in a consistent and integrated environment.

Open Adapter Pool (OAP) - The proposed architecture focuses on the core value proposition of the LMS and not providing proprietary learning tools such as blogs, wikis, and others. In Indian context there is a need to provide the course and group context to external tools in a low cost manner. This is possible now through available web services as well as Social Networks like Facebook, Orkut, Netlog and Twitter etc.

CLOUD E- LEARNING

Cloud computing is a technology that can bring new values to an e-learning system, because educational services should be delivered in a reliable and efficient manner. Cloud computing also provides a suitable environment for global learning activities. Finally, efforts to introduce cloud computing in e-learning environment have been initiated over the

last couple of years and on-going across the globe. Cloud computing technologies can run applications as services over the internet on a flexible infrastructure Afshari, M. (2014). Cloud computing provides a low cost solution to the academic institutions for their researchers, students and teachers. According to Afshari, M. (2014) the contribution of cloud computing to e-learning systems offer many benefits to the organization. They are:

- The cloud provides quality of service (QoS) - guaranteed infrastructure such as cost, time, reliability and hardware performance like memory size and CPU bandwidth and sustains SLA oriented resource allocation.
- The cloud provides resource utilization information and real time configuration, improves the usage rate of resources and allocates resources on demand.
- The cloud provides support to many applications, building it convenient and rapid to get the required computation and storage resources.
- Through the automatic resource allocation management, labor intensive jobs can be achieved and emergencies can be solved rapidly. Hence the cost is reduced.

In these days Cloud computing is acting as an emerging technology. It is a kind of computing which uses virtualized and highly scalable resources that can be shared by the users. Users need not be aware of the resources that they are using through cloud computing. A user on the Internet can communicate with many servers at the same time and these servers exchange information among themselves. Cloud Computing also known as on demand computing or internet as platform is currently one of the new technology trends will have a major impact on teaching and learning environment in coming days.

Cloud computing technology makes e learning solutions possible for mobile phones and other devices such as tablets, smart phones, PDAs etc. In recent days many companies emerge in market to offer the cloud power to many technical solutions to make their products more cost effective and enhancive with the cloud power. The accelerated development in Information Technology and the necessity for enhanced learning environments by harnessing existing technologies and resources has created a need to teach students more effectively.

Cloud Computing appears to be one of the most beneficial technologies for this purpose due to its numerous characteristic such as: availability, scalability, agility, elasticity, and reliability for on demand services. These characteristics, among many others, can give the impression that Cloud Computing could significantly enhance the learning environment.

There are many advantages offered by cloud computing: improved performance of PCs, lower maintenance issues, lower hardware requirements for users, IT Infrastructure costs are lower, lower software cost, increased computing power, unlimited storage capacity, instant software updates, improved compatibility between operating systems, increased data security, Accessibility from a range of devices, portability of documents and easier group collaboration. On the other side there are some drawbacks of cloud computing: an internet connection is needed, low-speed connections ,limit accessibility and data security.

CLOUD-BASED LMS

In recent years, the share of consumers of cloud services not only for business purposes but also in training, is increasing. Studies and statistics show that revenues at the end of 2015 by using SAAS will grow to $ 22 billion. In 2015, there seems to be a tendency towards cloud-based LMSs, as 87% of the respondents were found to use a web-based LMS, compared to only 13% who have an installed LMS (4).

E-learning allows users to achieve good results in a short time. Many organizations and companies use the opportunities for training the staff at a convenient time and place. This contributes to improving the quality of personnel, its growth, which will allow the company to be competitive and achieve its objectives, reduces the cost of hiring new workers, train employees and redirects them to other sectors of the company (5).

Cloud-based LMSs are representatives of **SAAS** (Software-as-a-Service) and integrate key features of the traditional LMS and the functions of cloud services.

A new term is introduced – **EsaaS- Education Software-as-a-Service**, describing cloud services training as a new model for training (6).

Table 1 presents the differences between traditional educational software and systems and cloud-based services for education.

	Traditional Education Software	ESaaS
Platform	Multi version	Single platform
Pricing	Maintenance + License	Subscription (all inclusive)
Delivery	Installed	Hosted
Development	Longer Cycle	Continuous Cycle
Allocation	Capitalised	Expensed
Additional Cost	Installation, Maintenance, Customization & Upgrades	Configuration
Profits	Initial Sale	Ongoing
Sales Focus	Close the deal	Prove Value
Feedback Cycle	Long	Short
Success	New License revenue	Lack of Churn
Updates	Longer, less frequent	Shorter, Frequent

Table 1. Difference between the traditional educational software and ESaaS.

EMERGING LMS ISSUES

This exploratory paper reveals top ten evolving LMS issues derived from the diverse perspectives and resources: 1. “Home-grown” LMSs are on the decline 2. Standards based LMS like Moodle moves to the front of the LMS adoption pack 3. Hosted options for LMSs are achieving popularity 4. Open source, open applications, and open education resources are on the rise 5. Blackboard gains corporate LMS market share 6. Commercial LMS customers: less formal, more holistic 7. Extensibility matters 8. Campuses and business alike are slow to adopt “Enterprise 2.0” 9. The recession continues to constrain 10. Revising standards, specifications, and structures Previously standard was driving force for LMS core design, later structures and security become the decision drivers for the next generation of learning containers. Learners are exploring new sites and resources daily, and IT executives are wondering how to leverage the power of social media while continuing to protect data and keep information behind the firewall. Another new understanding in the ROI conversation is a renewed focus on reusable, modular, and shared content.

Literature Review by Allen suggests that there might be a trade-off between LO maintainability and context-related learning, which requires more complex RLOs. Further Clark/Mayer point to the results of a large number of empirical media comparison studies, which indicate that the type of media used in instruction does (in most cases) not have an effect on learning outcomes: “When the instructional methods remain essentially the same, so does the learning, no matter how the instruction is delivered.”

Further the pressure is mounting to design complex LMSs for efficiently conveying knowledge together with real life context to a dynamically growing number of individual learners.

SELECTION CRITERIA FOR CLOUD-BASED LMS

An important condition for achieving efficiency in e - learning is the selection of appropriate e-learning environment. It requires exploring among the available cloud-based LMS because not all of them offer the same services, conditions for maintenance and customization.

This necessitates the establishment of criteria for their evaluation to be implemented to meet the needs of the organization.

Some of the features that a cloud-based LMS should possess are:

- **Scalable** – to support large number of users;
- **Flexible** - to meet the needs of consumers;
- **Social features** – to support communication and social connectivity between users through blogs, forums, link with social networks, collaboration tools for working on common projects
- **Tracking the progress of learners** – to support tracking the success and activity of users through various statistics and reports;
- **Customizable** – to provide opportunities for organizing learners into groups and classes and the opportunity to customize the look of each organization;
- **Security** – to provide security from external and internal attacks, as well as tools for their follow-up;
- **Support** – ongoing 24/7 support from specialists.
- **Easy for use** – no training required;
- **Integration** with other systems and platforms (Google Drive, Dropbox, YouTube, Flickr)
- **Standards** (SCORM) – support standards for packaging and integrating e-learning courses in different LMSs.

CONCLUSION

As a conclusion of Cloud Computing is an exciting development is a significant alternative today’s educational perspective. Students and administrative personnel have the opportunity to quickly and economically access various application platforms and resources through the web pages on-demand.

The growing popularity of cloud services and cloud-based LMSs require vendors to provide secure and protected systems to meet consumers’ needs. Affordability and pricing plans for each organization is a prerequisite for their competitiveness. The main

features that should have such systems concern provision of conducting quality e-learning, communication and collaboration between participants and tools for creating a variety of learning resources and activities.

The LMS industry is clearly at a tipping point in its evolution, with transformation taking place on two distinct fronts. On the technological front, expectations of the learning and IT marketplaces are bringing pressures to provide a better experience than that provided by systems designed to monitor and distribute online courses tracked by a departmental-level database that stores course files, some student records, test results, and course syllabi. In other words, learners expect to have as good an online learning experience as they have when satisfying online consumer experiences. The Evolution of the LMS from Management to deep analysis of trend, shaping the future of e-Learning.

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Corresponding Author

Mohammed Khalid Kaleem*

Research Scholar, Maharishi University of Information Technology, Lucknow, India

E-Mail – khalid_ccbc@yahoo.ca